

Fresnel Lens Gamma Ray Telescope

Thermal

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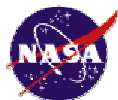




TCS Summary

♦ Thermal Control Methods

- **Lens Spacecraft**
 - Standard MLI blankets, coatings, heaters, thermostats, etc.
- **Detector Spacecraft**
 - 80 K multi-stage radiant cooler
 - -30°C radiator and sunshield(s)
 - Standard MLI blankets, coatings, heaters, thermostats, etc.



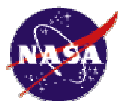
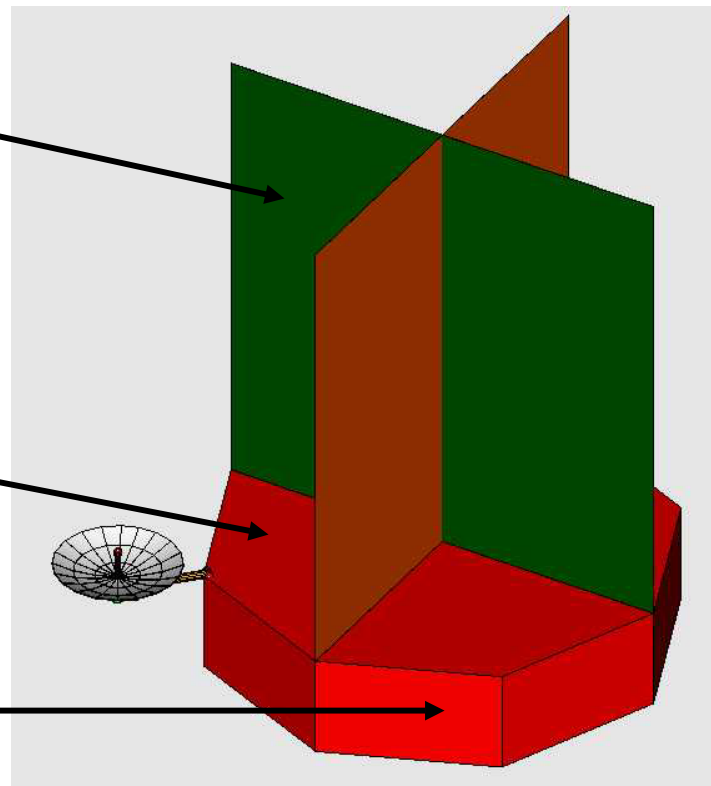


TCS Configuration Lens Craft

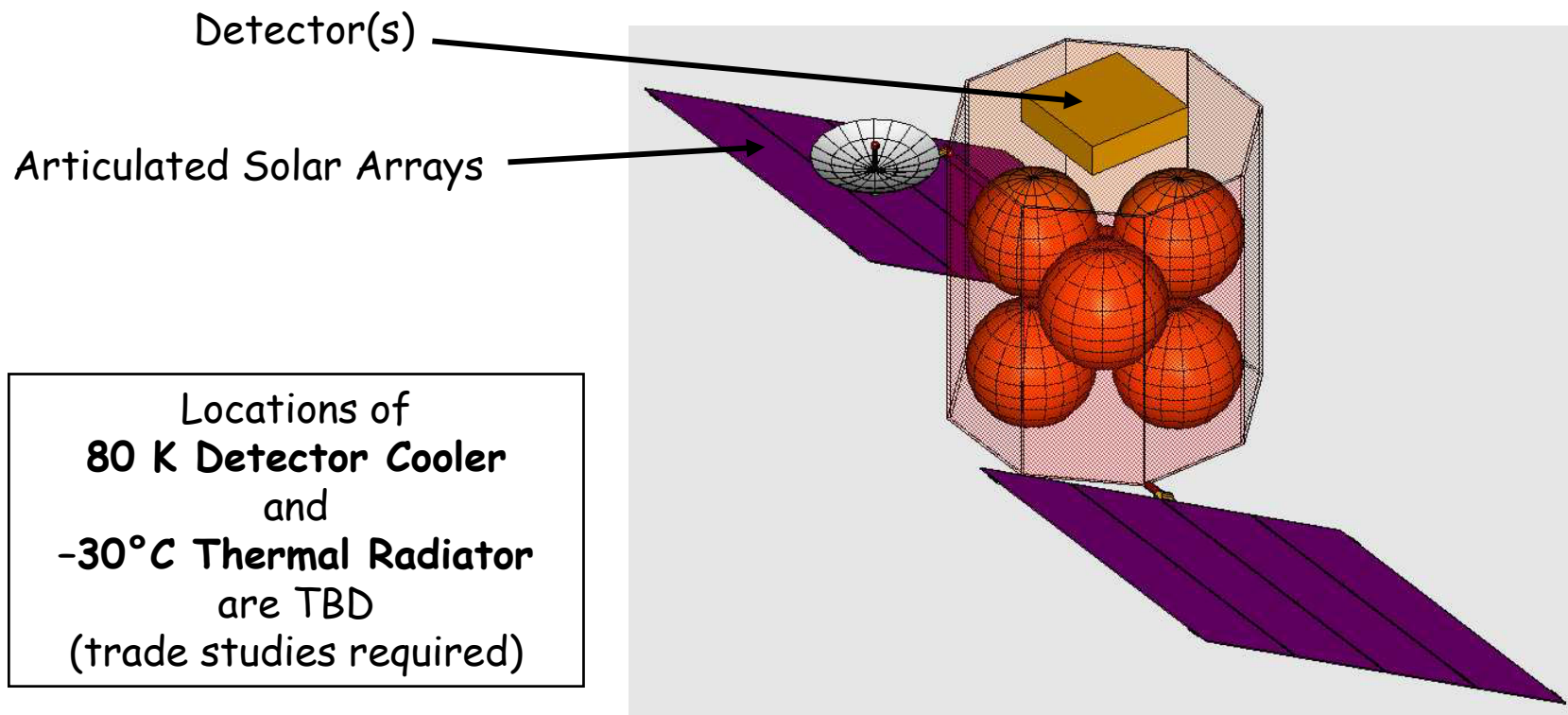
MLI Covered Lenses

Thermal Radiators on
Upper/Lower S/C bulkheads

Body-mounted Solar Arrays



TCS Configuration Detector Craft

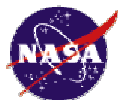




Thermal Design - Lens Craft

◆ No Obvious Thermal Challenge

- Lenses wrapped in Multi-Layer Insulation to mitigate wide temperature swings due to varying sun angles.
- Apply conventional thermal design approach to S/C Bus (MLI, coatings, heaters, etc).

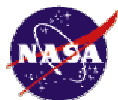




Thermal Design - Detector Craft

♦ Challenges (but perhaps not insurmountable)

- **Passive Radiant Cryocooler for 80 K Detector(s)**
 - Heat rejection capability of this technology is limited (less than 1.6 Watts per m² of cooler area).
 - Passive cooler requires careful placement and will impose various constraints: large keep-out zone for sun, unobstructed field of view, sensitivity to contamination.
 - Alternatives considered:
 - thermoelectric cooler - not feasible for this temperature range
 - stored cryogen - lifetime, mass issues.
 - active cryocooler (e.g. reverse turbo-Brayton) - new technology still in development, higher power requirements.
- **Large Thermal Radiator for -30°C Detector Array**
 - At least 1m² required for 150 W dissipation
 - This radiator will impose constraints similar to above.
 - Swift/BAT detector array has stringent temperature uniformity requirement (satisfied with manifold of heat pipes).



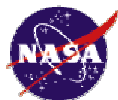


TCS Resource Estimate

♦ Resource Estimate Assumes 1 Lens Craft and 1 Detector Craft

Does not address TBD Thermal Requirements of TBD Metrology System

- Mass: 50 kg (36 kg MLI, 14 other)
- Power: TBD (heaters)
- Hardware Cost: \$XXX (heat pipes & cryocooler: \$XX M)
- Manpower: \$XXX (2.5 FTE over 4 years)





Thermal Design Issues

- ◆ Design/placement of thermal radiators and propulsion system lines of thrust must be traded against potential observing constraints.
- ◆ If thermal dissipation of 80 K detectors is too large (more than a Watt or two), radiant cooler may be impractical. Other cooling systems may require more spacecraft resources and/or technology development.
- ◆ If -30°C detector plane has stringent temperature uniformity requirement, heat pipe system similar to Swift/BAT may be required.
- ◆ Anticipate significant thermal requirements associated with micro-arc-second metrology system (thermally-induced distortions).

